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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/695,374	10/28/2003	Mark S. Chace	FIS920030172US1	5323

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EXAMINER

DRODGE, JOSEPH W

ART UNIT	PAPER NUMBER
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1723

DATE MAILED: 04/06/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

## Office Action Summary

Application No.

10/695,374

Applicant(s)

CHACE ET AL.

Examiner

Joseph W. Drodge

Art Unit

1723

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

### Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

### Status

- 1) ☒ Responsive to communication(s) filed on 03 March 2006.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

### Disposition of Claims

- 4) ☒ Claim(s) 1-17 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1-17 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

### Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

### Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some \* c) ☐ None of:
- ☐ Certified copies of the priority documents have been received.
  - ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
  - ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

### Attachment(s)

- ☒ Notice of References Cited (PTO-892)
- ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)  
Paper No(s)/Mail Date \_\_\_\_\_
- ☐ Interview Summary (PTO-413)  
Paper No(s)/Mail Date. \_\_\_\_\_
- ☐ Notice of Informal Patent Application (PTO-152)
- ☐ Other: \_\_\_\_\_

Art Unit: 1723

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

The factual inquiries set forth in *Graham v. John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

Claims 1-13 are rejected under 35 U.S.C. 103(a) as being unpatentable over Shaffer et al Document US2002/0052125 in view of Chua et al patent 6,121,130 and McCullough et al patent 5,908,510.

Shaffer et al disclose a process for forming an etched, coated semiconductor device followed by removing impurities that comprises: disposing a low dielectric constant curable organic polymeric film, generally as a multi-layer film (Abstract, paragraphs 25-27 and 63 in particular) on an electrically conductive surface of a semiconductor substrate device (paragraphs 3-4,81, etc.), curing the film layers (paragraphs 65-68) and contacting the film layer(s) with heat in a baking step, to remove impurities from the film and device ( paragraph 66).

The claims all differ in requiring the contacting to be with supercritical carbon dioxide. Chua et al teach to remove both residual solvent and polymerization by-products from a semiconductor substrate coated with a film by thermal steps (column 4, lines 1-8). McCullough et al teach to remove residue from semiconductor devices that may include etched and patterned composites having both silicon and polymeric layers (column 5, lines 38-56) by contact with supercritical carbon dioxide and optionally additives (column 5, lines 1-29), the contacting generally being at a significantly elevated temperature (column 5, lines 1-3 and column 6, lines 1-6). ***The semiconductor devices cleaned by supercritical carbon dioxide may include patterned film structures comprised of low dielectric polymer such as polyimide (column 5, lines 43-55). Shaffer mentions in paragraph 23 that polyimides may be used as the low dielectric filming polymer.***

It would have been obvious to one of ordinary skill in the art to have enhanced the Shaffer et al process, by contacting the cured and coated semiconductor device with supercritical carbon dioxide, to more thoroughly and completely remove a variety of

Art Unit: 1723

residual impurities from the device, as suggested by Chua et al and McCullough et al, to result in precision surfaces that are free of defects.

Regarding claims 2-7, polymeric films containing layers comprising polyarylene resin, including formulations obtained by precursors including biscyclopentadienone are also taught by Shaffer et al at paragraphs 25-27.

Regarding claims 8-12, polymeric films comprising layers of polysilsesquioxane are also taught by Shaffer et al at paragraphs starting with paragraph 32 and 63.

For claim 13, the film is applied at multiple, intra or inter-levels or layers in Shaffer et al (see figures, Abstract, etc.).

Claims 1-13 are rejected under 35 U.S.C. 103(a) as being unpatentable over McCullough et al patent 5,908,510 in view of Shaffer et al PGPUBS US2002/0052125. McCullough et al disclose forming of a semiconductor substrate or wafer (column 1, lines 33-43), disposing a low dielectric constant curable polymeric film, such as polyimide or other polymer, on the electrically conductive surface (column 1, lines 33-43 combined with column 5, lines 43-55) and then cleaning the film surface by contacting the surface with supercritical carbon dioxide to remove residues and impurities (text beginning at column 5, lines 57-62).

The claims differ in requiring the film to be cured. However, Shaffer et al teach curing of the polymeric film on the semiconductor substrate at paragraphs 65-68. It would have been obvious to one of ordinary skill in the art to have augmented the method of McCullough et al by adding the step of curing the polymeric material, as

Art Unit: 1723

taught by Shaffer, in order to permanently adhere the film to the substrate, and prepare the device for etching.

Regarding claims 2-7, polymeric films containing layers comprising polyarylene resin, including formulations obtained by precursors including biscyclopentadienone are also taught by Shaffer et al at paragraphs 25-27.

Regarding claims 8-12, polymeric films comprising layers of polysilsesquioxane are also taught by Shaffer et al at paragraphs starting with paragraph 32 and 63.

For claim 13, the film is applied at multiple, intra or inter-levels or layers in Shaffer et al (see figures, Abstract, etc.).

Claims 14-17 are rejected under 35 U.S.C. 103(a) as being unpatentable over Shaffer et al in view of Chua et al and McCullough et al as applied to claim 1 above, and further in view of Jur et al patent 6,558,475.

Alternatively, Claims 14-17 are rejected under 35 U.S.C. 103(a) as being unpatentable over McCullough et al in view of Shaffer et al as applied to claim 1 above and further in view of Jur et al.

Claims 14-17 further differ in requiring the contacting of the supercritical carbon dioxide to be accompanied with at least one solvent (or co-solvent). Jur et al teach, in a method explicitly aimed at improving on the method of the applied McCullough reference (column 2, lines 48-53), to clean semiconductor device surfaces with supercritical carbon dioxide accompanied by co-solvents (especially column 5, lines 22-52). It would have been further obvious to one of ordinary skill in the art at the time of the invention to have added co-solvents to the supercritical carbon dioxide in the

Art Unit: 1723

McCullough/Shaffer et al process, as taught by Jur et al, since carbon dioxide alone cannot remove all types of contaminants present and a greater portion of the contaminants can be removed by combination of carbon dioxide and co-solvent.

For claim 15, the solvents employed by Jur et al include alcohols and ketones (column 5, lines 47-51). For claims 16 and 17, although Jur is silent as to exact portion of solvent, he states that "measured amounts of solvent are added to the carbon dioxide" at column 7, lines 54-60.

Applicant's arguments filed on March 3, 2006, with respect to rejection of claims 1-13 based on Shaffer et al as a primary reference, have been fully considered but they are not persuasive.

It is argued that McCullough is far removed from teaching of contacting a low dielectric constant cured film surface with supercritical carbon dioxide to remove impurities therefrom.

***It is submitted that the semiconductor devices cleaned by supercritical carbon dioxide, in McCullough, may include patterned film structures comprised of low dielectric polymer such as polyimide (column 5, lines 43-55). Shaffer mentions in paragraph 23 that polyimides may be used as the low dielectric filming polymer. The only detail lacking in McCullough is teaching of the polymer being cured. However, curing of polymeric films on substrates is well known in semiconductor device processing and details of curing are taught in detail in Shaffer.***

Art Unit: 1723

Applicant's arguments with respect to claims 14-17 have been considered but are moot in view of the new ground(s) of rejection. Note that an additional new ground of rejection has also been applied to claims 1-13 based on McCullough et al as a primary reference.



Art Unit: 1723

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Joseph Drodge at telephone number 571-272-1140. The examiner can normally be reached on Monday-Friday from 8:30 AM to 5:00 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Wanda Walker, can be reached at 571-272-1151. The fax phone number for the examining group where this application is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either private PAIR or Public PAIR, and through Private PAIR only for unpublished applications. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have any questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

JWD

April 5, 2006

  
JOSEPH DRODGE  
PRIMARY EXAMINER